

PSYCHE.

FURTHER NOTES ON SOME TINEID LARVAE.

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(Continued from page 137.)

The regular ratio of growth between the different stages of these minims would scarcely be believed by one unfamiliar with such facts: thus the lengths of this species (*N. pteleuella*) at its several molts are, as above stated, 0.8, 1.6, and 3.2 mm., and to adopt the language of the anthropologists, its "cranial capacity," as indicated by the width of the head at the widest point, is in the different casts of the same larva, 0.0825, 0.165, and 0.33 mm.

The mine is a very pretty one; and several of them together give to a leaf a very singular appearance. The mines frequently cross themselves and each other, and sometimes almost the entire contents of a leaf are eaten out. There is a similar mine in oak (*Quercus*) and another in hickory (*Carya*). In these however there is no little blotch at the beginning, the frass is deposited in a central line in the first part (corresponding to the first stage of larval life?), as it also is in the last 12 mm. of the mine, as in this species. This last character is preparatory to leaving the mine to pupate, and does not indicate a molt accomplished, as the other changes in the character of the mine do; but it

is probable that every change in the mode of feeding, and in the character of the mine, and every decided break in the continuity of the frass made by a larva in early life, indicates that it has just completed a molt. Yet there are many *Nepticula* mines in which I have not only failed to find any molt, but also have failed to find any indication of one. Perhaps the enlargement of the mine of *N. fuscotibiaeella* two days before it ceases to feed may indicate that a molt then takes place, but I have not found that it does.

The only cocoons that I have seen were yellowish green and about 2 mm. long; they were between the side of the glass breeding jar and the earth in the bottom of it. Does it pupate under ground?

Aspidisca saliciella Cham. The egg is deposited usually at the side of the midrib in willow leaves [*Salix*]; the larva makes a mine just wide enough to hold it, along the midrib, and 2.12 mm. long; here it undergoes its first molt, being at the time 1.06 mm. long. It then leaves the midrib and makes a clavate mine 3.36 mm. long, when it undergoes

its second molt, being now 2.12 mm. long. It then eats out the parenchyma, making a small irregular roundish blotch from which it cuts out the little oval case in which it pupates. Its length after it has finished feeding is 4.24 mm. The larva hibernates; in all of its stages, except as hereinafter stated, it is pale yellow with a fuscous spot on the under surface of each segment except the head and anal segment, and two hairs (one of them very small) project from each side of each of the same segments. The body is cylindrical and depressed; feet are represented (?) by sucker-like discs, and the trophi from its exit from the egg are of the ordinary form, that is the spinneret, maxillae and palpi are distinct, as well as the other organs. Each molt in the mine occupies twelve hours. It is only recently that I have been able to follow its life history, having formerly supposed that it molted only once. The width of the head of each cast is, 0.101, 0.202, 0.303 mm. I give these figures as showing the regularity of the relative sizes of the same insect at its different molts. But it will be observed that there are two ratios. In *Aspidisca* and *Nepticula* the larva in each stage increases its length by adding the length of the preceding stage, as 1.06, 2.12, 4.24 mm. and 0.8, 1.6, 3.2 mm.; whilst in *Lithocolletis*, *Leucanthiza* and others the length of the larva at the end of its first stage is added in each of its succeeding feeding stages (0.81, 1.62, 2.43, 3.24, 4.05 mm.). In *Aspidisca* and others what corresponds to the third molt of *Lithocolletis* and others seems to be skipped, and a double length added at the fourth. In many larvae there is, however, a fifth molt, which seems to be

the equivalent of the sixth one in *Lithocolletis*, the fifth also being skipped.

The larva undergoes another (its third) molt in its case, after the case has been attached for pupation, but previous to the molt by which the pupa is formed. If the case is opened, some days after it has been finally attached, a white silken cocoon will be found inside, fitting closely to the body of the pupa, and the cast skin will be found between the cocoon and the case. There are therefore four larval stages. In the last stage the appearance of the larva differs greatly from that of the previous stages. It is now yellow, without maculae, and the sucker-like spots on the thoracic segments have disappeared. I have long known the larva in this condition, but only recently discovered that it attained it by a third molt, though the difference in its appearance suggested as much. Prof. J. H. Comstock, in his "Report of the Entomologist of the U. S. Department of Agriculture, for the year 1879," pl. 2, fig. 2, *b* and *c*, gives figures of these last two (or third and fourth) larval stages.

The mode of progress in the larvae of *Aspidisca* is one of the most surprising in the insect world. As above stated there are no true feet or prolegs; every vestige of them has vanished except on the second and third thoracic segments, where they are represented (?) by the little sucker-like discs before mentioned. But these discs are not suckers. They are distinct depressions both on the ventral and dorsal surfaces. They do not exude any glutinous or other secretion by which the larva gains foothold. The larvae are thus apparently without any means of progress. Yet encumbered by

their case, and with the whole body enclosed except the head and first, and sometimes the second, segment, they will climb trees and fences, travel through and over grass and weeds and irregularities of ground for distances sometimes of many metres before they finally attach their cases. I was long puzzled to know how they accomplished it, supposing that it was by means of the discs, by suction or by exuding from them a glutinous secretion. Experiment and observation have solved the problem. There is no suction or secretion; and the discs have nothing to do with it; they are not organs of locomotion. The larvae travel solely by means of their silk. The head and following segment, and sometimes the next, are protruded from one end of the case (the larvae sometimes close one end and open the other), then successive taps are given with the end of the spinneret to the surface on which the larva lies, and thus a minute byssus is formed, to which the spinneret adheres; the body is then contracted so that the under surface of the case is brought into contact with the byssus and apex of the spinneret, and thus the case is attached. The head and segments are again extended, and another byssus is made, and, the body contracting, the case is again brought up and attached. Its attachment is only by a few silken threads each of which is less than 0.0002 mm. in diameter, and the fresh silk readily stretches or breaks. This is the sole mode of progress of the larva.

I have not followed the changes of *A. splendoriferella* or any of the species other than *A. saliciella*; but the mines and larvae of all resemble each other so

much that there is no reason to suppose there is any difference in their histories other than such as relates to size, ornamentation and food plant.

Autispila. In this genus I know the species *nyssaeifoliella*, *cornifoliella*, *viticordifoliella* and *ampelopsiella* in their last and penultimate larval stages. In their last stage all are fat, white, footless larvae; the first then having a length of 4.07 mm. when fully grown, and the last of 3.30 mm. In the penultimate stage all have the ventral maculae on all of the segments, except the head and the two hindmost segments of the abdomen. I have never seen a molt in any of the species, but there has evidently been a molt between the two stages above mentioned, and I have found the cast skin of this molt in the mines. From the size of these two stages, and from the size and form of the mine, and from analogy with *Aspidisca*, I have no doubt that there is an earlier molt which takes place in the first three above-mentioned species when the larva is about 1.35 mm. long; and in *ampelopsiella* when it is about 1.1 mm. long. I know the larvae of *A. hydrangeaeella* Cham. and *A. isabella* Clem. only in their penultimate stages. They are very much like the other larvae. *Isabella* in size agrees with *viticordifoliella*, and *hydrangeaeella* is but little larger than *ampelopsiella*. The mines of all greatly resemble those of *Aspidisca*, but are larger; and like nearly all Tineid mines known to me they are at first linear, ending in a blotch which frequently obliterates more or less of the linear part of the mine. They no doubt leave their eggs with mouth parts of the ordinary form, like *Aspidisca* and *Nepiticula*.